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PHOTOCATALYTIC FIBERS AND ITS PRODUCTION METHOD

[光触媒繊維及びその製造法]

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(54) [Title of the Invention] Photo catalytic fibers and its production method

(57) [Abstract]

[Purpose] This provides the photo catalytic fibers that improve the utilization rate of the photo catalyst.

[Structure] The production method of the photo catalytic fibers in which the photo catalysts are carried on the optical fibers with light leaking part, and the photo catalysts are fixed on the optical fibers with light leaking parts formed in advance, or after fixing the photo catalysts on the optical fiber, light leaking parts are formed.

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[Claims]

[Claim 1] Photo catalytic fibers are such that photo catalysts are carried on the optical fibers with light leaking parts.

[Claim 2] The production method of photo catalytic fibers is characterized such that the solution is coated and fixed on the optical fibers surface where light leaking parts are formed in advance in which said solution has the adhesive characteristics with photo catalysts dispersed, or, after said solution is coated on the said optical fibers surface, and fixed, then, light leaking parts are formed.

[Claim 3] The production method of photo catalytic fibers is characterized such that the water dispersed solution of the photo

catalysts are coated and fixed on the optical fibers surface where light leaking parts are formed in advance or after said water dispersed solution is coated and fixed on the said optical fibers surface, then, light leaking parts are formed.

[Claim 4] The production method of the photo catalytic fibers is characterized such that partial hydrolyzate of organo metallic compounds is coated on optical fibers surface with light leaking parts formed in advance, next, said hydrolyzate is condensed, the photo catalysts to be formed is fixed or said hydrolyzate is coated on the optical fibers surface, and condensed, then after the photo catalysts to be formed is fixed, then light leaking parts are formed.

[Claim 5] The production method of photo catalytic fibers is characterized such that photo catalysts are accumulated and fixed on the optical fibers surface with light leaking parts formed in advance by gas phase deposition method or photo catalysts are accumulated and fixed on the optical fibers surface and fixed by gas phase deposition method, after which, light leaking parts are formed.

[Detailed Description of the Invention]

[0001]

[Utilized field in industry] The present invention is related to the photo catalysts fibers used for the optical chemical reaction and decomposition and its production method.

[0002]

[Prior Art] Traditionally, that water is optically decomposed using titanium oxide as photo catalysts are well known as [Honda Fujishima effect], and as its application, antibacterial tiles and soil removing glass have been developed in which the titanium oxide is coated on the tile surface and glass surface, bacteria and attached soiling are decomposed in the presence of water and light. In purifying water, for instance, Japan Unexamined Patent Tokkai Hei4-24429 Gazette is known in which using the titanium dioxide powder as the photo catalyst, the organic substance in the discarded water is decomposed by catalytic oxidation, thus, using the chemical reaction and decomposing by light has been done traditionally in many ways.

[0003] However, since lights has characteristics of rectilinear propagation, the parts that are not hit by light are easily produced, particularly, in combining with photo catalyst, the big defect is that the catalytic efficiency is low. And if the photo catalysts are powdery, the problem is that it requires a big energy in recovering the powdery catalysts.

[0004]

[Problems the Invention Attempts to Solve] The present invention was the result of studying in order to demonstrate the photo catalysts action even at the place where it is difficult for the light to reach, and the purpose of the present invention is to provide the photo catalytic fibers in which the utilization rate of photo catalysts are improved.

[0005]

[Means for Solving the Problems] The gist of the present invention is the production method of the photo catalytic fibers wherein The photo catalysts are carried on the optical fibers with light leaking part, and the photo catalysts are fixed on the optical fibers with light leaking parts formed in advance, or after fixing the photo catalysts on the optical fiber, light leaking parts are formed.

[0006] Regarding the photo catalytic fibers of the present invention, the optical fibers as the base fibers has the structure of combining different index of refraction, and is the optical fibers where the light can permeate inside the fibers, and inorganic optical fibers represented by quartz, acrylic resin, polystyrene resin,

polycarbonate resin, non crystalline poly olefin resin, silicon resins and the like that are organic type optical fibers can be listed.

[0007] Regarding the optical fibers of the present invention, the optical fibers that carries photo catalysts are required to have light leaking parts, and the methods are used to form the multiple light leaking parts on the fibers surface wherein light leaking parts are formed by attaching cuts to the fibers surface, the light leaking parts are formed on the fibers surface by bending the fibers.

[0008] As the photo catalysts carried on the optical fibers are ,for instance, titanium dioxide, zinc oxide, tungsten trioxide, niobium oxide, zirconium oxide, cerium oxide, silicon dioxide and the like that are metallic oxide and zinc sulfide, copper sulfide, cadmium sulfide and the like that are metal sulfide.

[0009] Regarding the photo catalytic fibers of the present invention, base fibers are the optical fibers, hence, it is flexible, and inside of the vessel that is made of metal and opaque or in the densely colored liquid or the in the muddy solution or under the pressurization, the light can be passed inside the photo catalysts fibers from outside, thus, chemical reaction and decomposition are executed by photo catalytic action. For instance, if the photo catalytic fibers of the present invention are used, the sludge at the bottom of the water can be decomposed.

[0010] And, regarding photo catalytic fibers, multiple can be used as is, or bundled up or arranged in rows, however, due to the standpoint of widening the catalytic area, it is preferred that the incoming part of the light is in bundled or taped state, and the light leaking parts of each fibers can be used without being subjected to the restricted state.

[0011] Regarding the photo catalytic fibers of the present invention, the light used for light reaction such as sun light and UV rays and the like are taken out from the light leaking parts, the light can be irradiated even on the target where the originally rectilinear light does not hit or can be not hit, and as the photo catalysts performance, since it presents fiber form, the catalytically active area is wide, and since the light hits the part where the catalysts exists, photo catalysts utilization rate is high, furthermore, since it is flexible as fibers, it can be used for wide range of objects.

[0012] Photo catalytic fibers of the present invention are produced by the following methods. (1). A method in which the solution with the adhesion with photo catalysts dispersed is coated on the optical fibers surface. In a greater detail, resin solution in which epoxy resin, acrylic resin or styrene resin and the like are dissolved in organic solution, silane coupling agent solution, the solution in which the photo catalysts power is dispersed in water glasses

and the like is coated on the optical fibers surface, and by polymerization curing or by heating the solution, it is evaporated and fixed.

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The polymerization curing can be done by heating reaction or by irradiating the active energy such as UV rays and the like.

[0013] (2). A method in which Water dispersed solution of photo catalysts are coated on the optical fibers surface and fixed. In a greater detail, photo catalysts powder is dispersed in water, this photo catalytic water dispersed solution is coated on the optical fiber surface, and water is evaporated by heating and drying, fixed. As photo catalytic water dispersed solution, locally sold titanium dioxide solution, zirconium oxide solution can be used.

[0014] (3). A method wherein partial hydrolyzate of the organo metallic compound is coated on the optical fibers surface, next, said hydrolyzate is condensed, and the photo catalysts formed is fixed. In a greater detail, as the organo metallic compound, titanium tetra isopropoxide, ammonium tungstate para penta hydride, niobium penta chloride, titanium tetra methoxide, photo catalytic fibers and titanium tetra ethoxide and the like are listed. Partial hydrolysis and condensation reaction are desired to be done by heating in the range of 25~ 800 deg C range.

[0015] (4). A method in which photo catalysts are accumulated and fixed on the optical fiber surface by gas phase deposition method. In a greater detail, using spattering method, ion plating method and the like that are gas phase deposition method, photo catalysts are accumulated on the optical fibers surface and fixed. In case spattering method, ion plating method are used, as the target compound with the photo catalysts action, it is desired to use the high purity compound with purity or 95% or more, and if the purity is low, it is difficult for accumulation to manifest the photo catalytic action. As the locally sold target material, there are titanium dioxide, tungsten dioxide, cerium oxide, zinc sulfide and the like.

[0016] And, regarding the method of producing photo catalytic fibers of the present invention, optical fibers are used in which the light leaking parts are formed in advance as optical fibers or after fixing the photo catalyst, light leaking parts are formed on the optical fiber. As to forming the light leaking part, as described already, methods are used wherein the light leaking parts are formed by damaging the optical fibers surface, or by bending the optical fibers, the light leaking parts are formed on the fibers surface on the outer side of the curved part and the like. In case the light leaking parts are formed after fixing the photo catalyst, a method is preferably used in which by bending the photo catalytically fixed

optical fiber, light leaking parts are formed on the fibers surface on the outside of the bending part. However, when bending, fixing means and bending means are suitably selected so that, when bending, photo catalysts are not peeled off.

[0017] In producing photo catalysts fiber, as to the form of the optical fibers, it can be bundled or taped optionally, hence, photo catalytic fibers form can take the optional form depending on the usage of the application. And as to the length of the optical fibers used, it is determined by considering the decreasing rate of the passing light, and amount of photo catalysts and the like, and optional length can be obtained depending on the object of reaction and decomposition.

[0018]

[Embodied examples] The following will explain the embodied examples of the present invention specifically.

[0019] (Embodied example 1). On the fibers surface of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, water glass with titanium dioxide powder dispersed is coated, heated and sintered, and fixed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped into the tri chloro ethylene diluted aqueous solution, and, sun beam is introduced from the end

part of the photo catalytic fibers, tri chloro ethylene was mostly decomposed in quite short time.

[0020] (Embodied example 2). Methyl ethyl keton solution of the low molecule weight poly methyl methacrylate with titanium dioxide powder dispersed is coated on the optical fibers made of poly methyl methacrylate, is dried at 50 deg C, and titanium dioxide is fixed. After that, this photo catalytically fixed optical fibers are twisted, and is provided with bends with small bending radius, thus light leaking parts are formed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped in 4- chloro phenyl solution, and light of 400 W mercury lamp is introduced from the end of the photo catalytic fibers, then, 4- chloro phenol was almost completely decomposed in quite a short time.

[0021] (Embodied example 3)). On the fibers surface, of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, dimethyl aceto amide solution of poly acrylo nitrile type polymer with titanium dioxide dispersed is coated, and it is fixed by water and fixed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped into the tri chloro ethylene diluted aqueous solution, and, the light of 400W mercury lamp is introduced from

the end part of the photo catalytic fibers, tri chloro ethylene was mostly decomposed in quite short time.

[0022] (embodied example 4)

On the fibers surface of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, water glass with mixed powder of 70 weight % of titanium dioxide /silicon dioxide 30 weight % dispersed is coated, heated and sintered, and fixed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped into salicylic acid diluted aqueous solution, and, sun beam is introduced from the end part of the photo catalytic fibers, salicylic acid was mostly decomposed in quite short time.

[0023] (embodied example 5) On the fibers surface of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, as the photo catalysts aqueous solution, it is dipped in the locally sold titanium dioxide solution (made by Taki Chemical Corp) and coated, heated and sintered at 50 deg C, and fixed, thus making photo catalytic fibers. The photo catalytic fibers obtained are dipped into chloro phenol diluted aqueous solution, and, sun beam is introduced from the end part of the photo catalytic fibers, chloro phenol was mostly decomposed in quite short time.

[0024] (Embodied example 6) On the fibers surface of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, it is dipped in iso propyl alcohol solution that contains 10 we% of titanium tetra isoproproxide and coated, and dried at 100 deg C, and heated and sintered at 600 deg C, and fixed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped into salicylic acid diluted aqueous solution, and, sun beam is introduced from the end part of the photo catalytic fibers,

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trichloro ethylene was mostly decomposed in quite short time.

[0025] (Embodied example 7)

On the fibers surface of quartz type optical fiber, using #2000 sand paper, fine cuts are inflicted, and multiple light leaking parts are formed, after that, It is placed inside RF spattering chamber, and under the 10^{-5}torr ambience air, and with the frequency of 13.56 MHz, using the spattering method, titanium dioxide (film thickness 1.5μm) is formed, thus making photo catalytic fibers. The photo catalytic fibers obtained is dipped into 4- chloro phenol diluted aqueous solution, and, 400W mercury lamp is introduced from the end part of the photo catalytic fibers, 4- chloro phenol was mostly decomposed in quite short time.

[0026]

[Effects of the Invention]

Regarding photo catalytic fibers of the present invention, light is introduced in the area where it is difficult for the light to reach, and photo catalysts are enabled to exist therein, and since the photo catalysts are carried in fibers conditions, and has a wide catalytic area, utilization rate of the photo catalysts is high, furthermore, it can be applied for wide range of object that uses optical chemical reaction and decomposition, and is particularly useful for decomposing the toxic substance and purifying them and for reaction and decomposition under pressurization.